2.7. Biodiversity – General

As a result of the early edicts of the country's Buddhist leaders, Sri Lanka can boast the world's first wildlife sanctuary, created by King Devanampiya Tissa in the 3rd century BC. Up to the colonial period large areas were put aside as Forbidden Forests: wilderness areas and watersheds. Deforestation started with the onset of the colonial era when the rulers were more bent on exploiting rather than conserving the natural resources. Under British rule large surfaces were cleared for their coffee, tea and rubber plantations and the slaughter of 'big game'. Also in the post-colonial era, the rate of deforestation remained alarming with the total forest cover being reduced to 50% over the last 4 decennia.

Nevertheless, biodiversity in Sri Lanka is still very high, as a result of an impressive habitat diversity caused by differences in temperature and rainfall according to altitude. Most groups of organisms include a large number of endemics. The vegetation supports over 3368 species of flowering plants (of which 26 per cent are endemic) and 314 species of ferns and fern allies (of which 57 species are endemic). Similarly, the country supports a high faunal diversity due to the varied climatic and topographic conditions prevailing in the island.

Within the territorial waters of the country, there are 38 species of marine mammals, including the sperm whale, the blue whale and a rare species of dugong. When compared to the extent of its shoreline Sri Lanka has limited true coral reefs. It is estimated that only 2% of the coastline has fringing coral reefs. There are widespread areas of patch reefs, but the extent of these has not been determined in detail. Most fringing reefs are found on the South-western, southern (e.g. Hikkaduwa, Unawatuna, Weligama) and eastern coasts (e.g. Pigeon Islands, Trincomalee). Well-developed offshore coral reefs occur in the Gulf of Mannar and west of the Kalpitiya Peninsula (Bar Reef). Coral reefs around the Jaffna Peninsula are less well developed, and occur mainly around the coastal islands. At present, only two coral reef areas have been afforded legal protection as Marine Protected Areas (MPA's) in Sri Lanka, namely the Hikkaduwa National Park in the south and Bar Reef Marine Sanctuary in the north west of the country. In addition, the area around the Great Basses and Little Basses reefs has been designated a Fisheries Protected Area. The coral reefs include 193 species of coral, over 300 species of fish and over 200 species of crabs. Five out of the eight existing marine turtle species (worldwide) regularly visit the sandy beaches of Sri Lanka to nest.

3. Main communities containing seaweeds

Seaweeds occur in three major marine communities: seaweed vegetations s.s., seagrass beds and mangrove forests.

Seaweed vegetations sensu stricto. They are best developed on rocky substratum; most benthic marine macroalgae are thus epilithic. Here they occur in the intertidal zone as well as above (in the spray zone) and under it (in the subtidal, on submerged reefs and rock boulders). Their development depends on the season and the surf (see chapters 4 and 5). Monospecific vegetations can occur, e.g. *Ulva fasciata* (Fig. 9A), *Sargassum* sp. (Fig. 9B), *Gracilaria corticata* (Fig. 9C), *Chaetomorpha antennina* (Fig. 9D) or *Dermonema virens* (Fig. 9E), but mostly tufts of different species are mixed or contiguous (Figs 10A-C), or different genera/species can really be intricated (Figs 10D-F). Mid and low intertidal rock pools generally contain a rich, continuously submerged seaweed flora which is different from the air-exposed substratum at low tide. High intertidal pools warm up too much and mostly contain coloured water (blooms of specific phytoplankters) with an elevated salinity (as a result of evaporation).

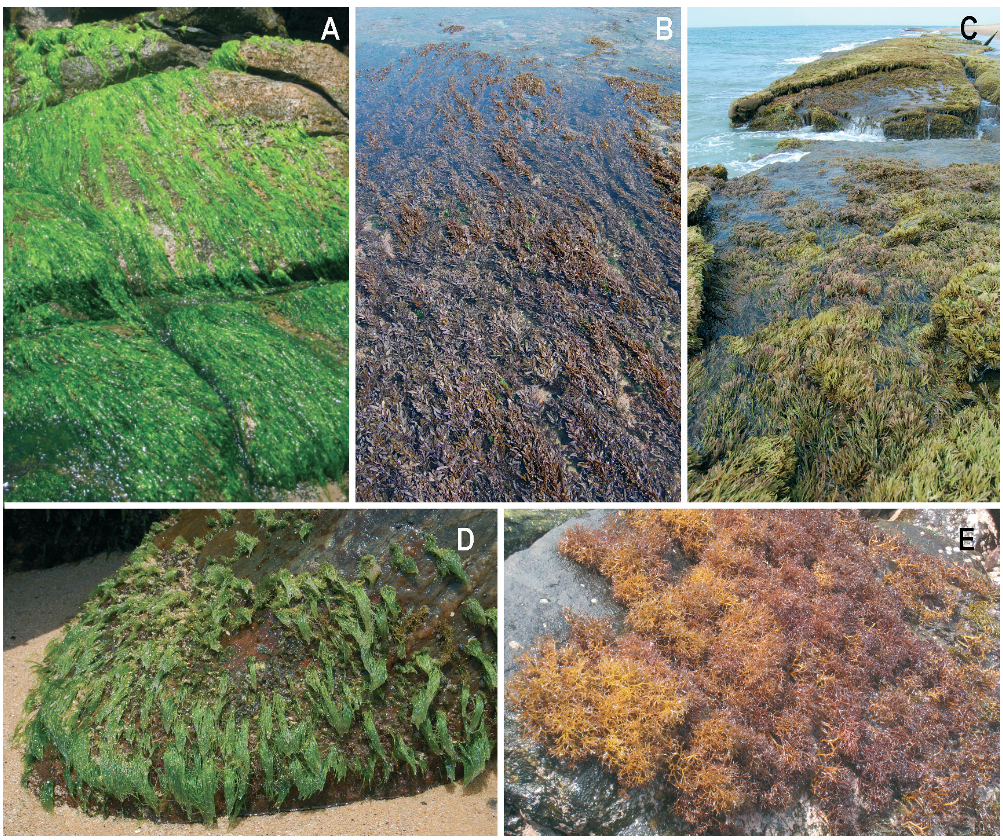

Fig. 9. Monospecific vegetations. A. Monospecific vegetation of *Ulva fasciata* (Dickwella); B. Monospecific vegetation of *Sargassum* sp. (Beruwela); C. Monospecific vegetation of *Gracilaria corticata* (Chilaw); D. Monospecific vegetation of *Chaetomorpha antennina* (Unawatuna); E. Monospecific vegetation of *Dermonema virens* (Nilwella).

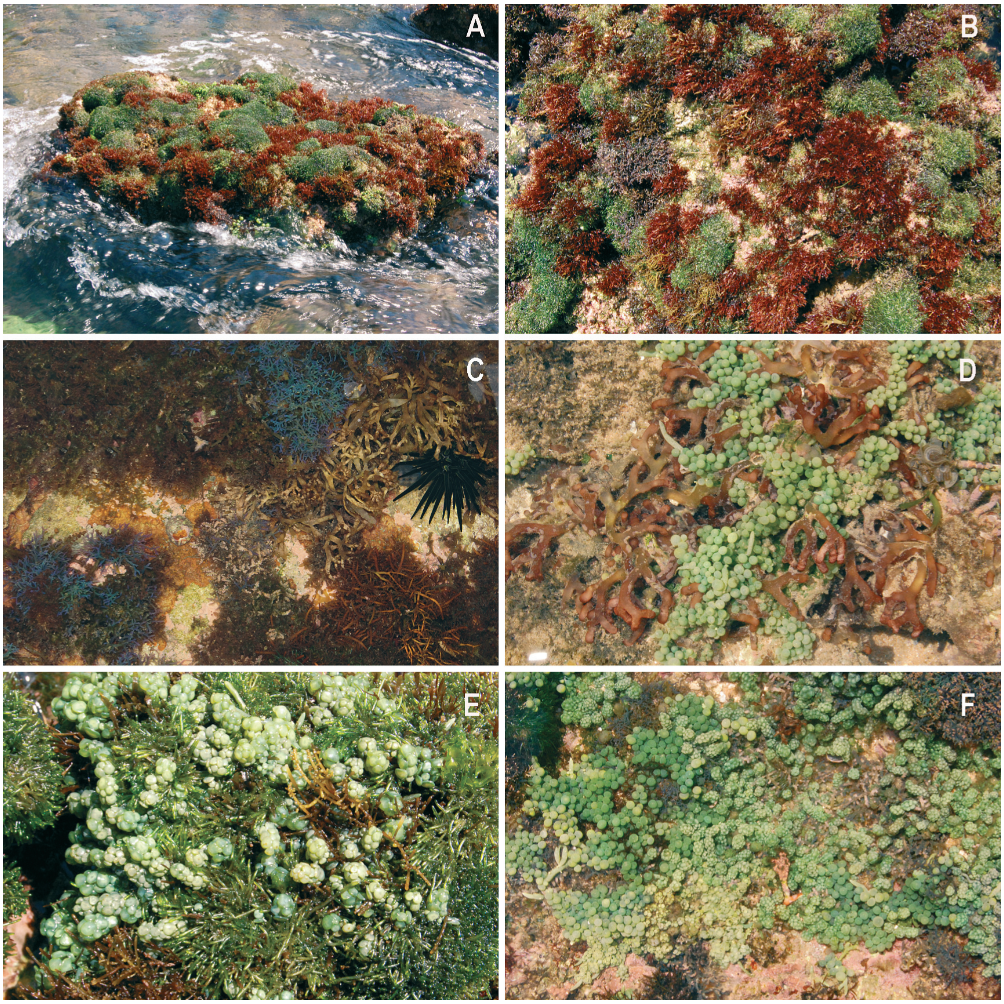

Fig. 10. Mixed vegetations and intricated seaweeds. A. Mixed vegetation of contiguous tufts of *Valoniopsis pachynema* (green bumps) and *Pterocladiella caerulescens* (Hikkaduwa); B. Detail of a mixed vegetation of *Valoniopsis pachynema*, *Pterocladiella caerulescens*, *Hypnea pannosa*, *Gracilaria corticata* and *Gelidiella acerosa* (Hikkaduwa); C. Detail of a mixed vegetation of *Hypnea pannosa*, *Polyopes ligulatus*, *Gelidiella acerosa, Laurencia* sp., *Laurencia natalensis* and others (Hikkaduwa); D. The green alga *Caulerpa racemosa* intricated to the red alga *Gracilaria crassa*; E. Intricated seaweeds: *Valoniopsis pachynema*, *Caulerpa imbricata*, *Gelidiella acerosa*, *Pterocladiella caerulescens*, *Ulva* sp.; F. Intricated seaweeds: *Caulerpa racemosa*, *C. imbricata*, *Chondria armata*, *Hypnea pannosa*.

In sheltered areas with sandy substratum, seaweed growth is limited due to erosion by shifting sands, but some seaweed genera can grow in this subtidal habitat (*Ulva*, *Padina*, *Acanthophora*, *Hypnea*, *Centroceras*, …), being attached to shell or coral fragments.

Fig. 11. Epiphytism. A. *Asteronema breviarticulata* forming epiphytic tufts on *Chnoospora minima*; B. Crustose Corallinaceae epiphytic on *Sargassum*; C. *Ceramium* cf. *taylori* epiphytic on *Caulerpa peltata* var.; D. *Laurencia* sp. epiphytic on *Sargassum*.

Many small algae (e.g. *Ceramium* spp., *Laurencia* spp., crustose Corallines) grow as epiphytes on different other seaweeds (Figs 11A-D).

Fig. 12. Seagrass meadows and associated seaweeds. A, B. Seagrass meadows becoming air-exposed at extreme low water (Nilwella); C. *Halimeda gracilis* growing between the submerged seagrasses in the lagoon (Weligama); D. *Caulerpa racemosa* partly growing between the seagrass *Thalassia hemprichii*, air-exposed at extreme low tide (Nilwella); E, F. Leaves of the seagrass *Cymodocea serrulata* covered by crustose Corallinaceae.

Seagrass ecosystems develop in surf-sheltered, subtidal biotopes. They thrive best in shallow lagoons (e.g. Puttalam Bay, Chilaw and Weligama lagoon) and protected bays. Some seagrass meadows become air-exposed at extreme low water (Figs 12A, B). Larger seaweeds (e.g. some species of *Chaetomorpha*, *Avrainvillea*, *Halimeda*, *Caulerpa*, *Codium, Tolypiocladia*) grow between the seagrass plants (Figs 12C, D) or on their stolons (e.g. *Hypnea* spp.); smaller ones grow as epiphytes on the seagrass stipes and leaves (e.g. species of *Dictyota*, *Laurencia*, *Ceramium*, *Polysiphonia*, small encrusting corallines, Figs 12E, F).

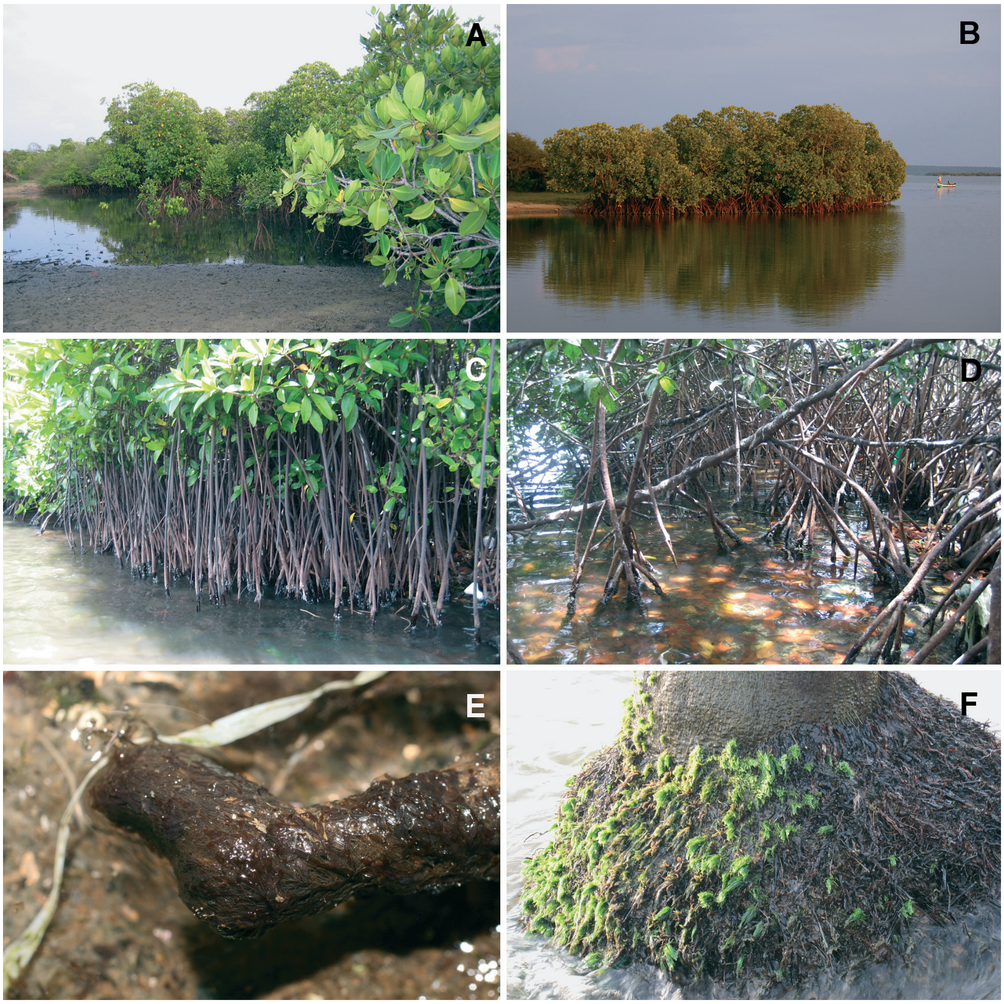

Fig. 13. Mangrove and associated seaweeds. A, B. *Rhizophora* mangrove (Kalpitiya); C, D. Rhizophores of *Rhizophora* sp. on which epiphytic algae develop (Chilaw lagoon); E. Detail of a rhizophore covered by *Caloglossa leprieurii* and *Polysiphonia* sp. (Chilaw lagoon); F. Basal part of a palm tree standing in the sea after coastal erosion and covered by seaweeds (Wattale).

Mangrove forests (Figs 13A, B) are best developed in sheltered, high intertidal to supralittoral zones. They occur mainly around lagoons and in estuaries. Some macroalgae develop in the mangrove tide channels (e.g. *Caulerpa* spp.), others in the silty pools in the mangrove vegetation (e.g. filamentous *Chaetomorpha* spp., tubular and blade-like *Ulva* species), others again on the aerial roots (rhizophores (Figs 13C, D) and pneumatophores) and the basis of the tree trunks (e.g. species of *Laurencia*, *Caloglossa*, *Catenella*, *Murrayella* and *Bostrychia*, Fig. 13E). As these algae are rather small and largely covered by sediments, they often go unnoticed. Even basal parts of palm trees standing in the sea after coastal erosion can be covered by seaweeds (Fig. 13F).

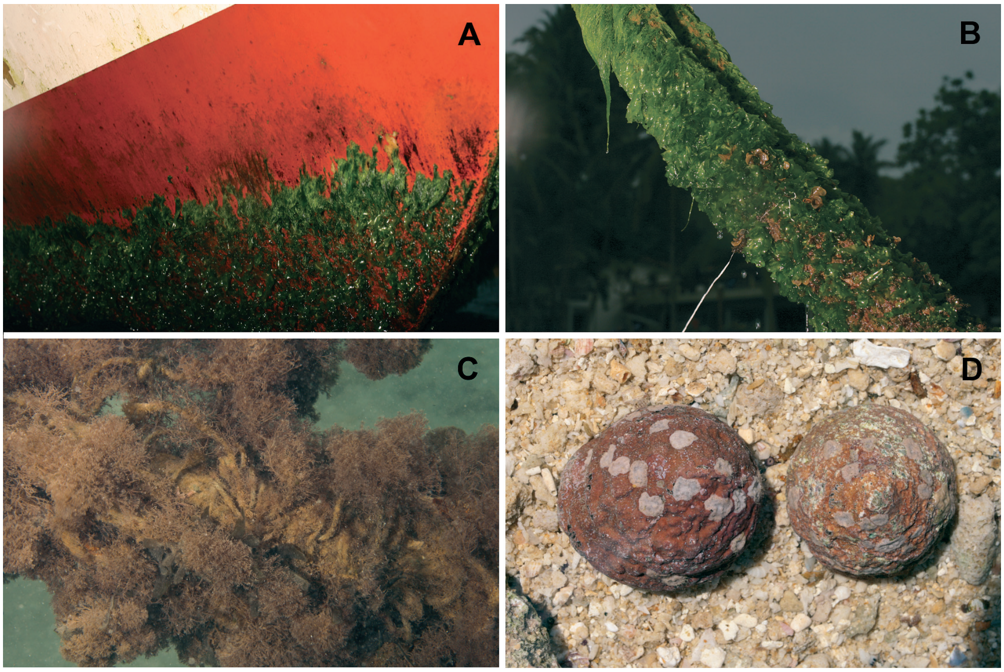

Fig. 14. Fouling and epizoic algae. A. Fouling on a boat: tubular and blade-like *Ulva* spp. (Beruwela); B. Fouling on a rope: tubular and blade-like *Ulva* spp. and *Padina* sp. (Beruwela); C. Fouling on a rope: dense vegetation of *Jania* (Weligama); D. A shell of a Gastropod covered by crustose coralline algae.

Fouling. Some seaweeds grow very well on floating hard substrata which are submerged or at least continuously wave-swept, such as boats and ropes (Figs 14A-C).

Seaweeds can also develop on animals (they are then called epizoic), such as shells of Gastropods (Fig. 14D).

4. Seasonality

As a result of the seasonal monsoons, the macroalgae of the intertidal and supralittoral zones show a well-marked seasonality. From June to November these parts of surf-exposed rock outcrops show a very dense seaweed cover (*Porphyra* spp., *Dermonema virens*, *Chnoospora minima*, *Asteronema breviarticulata*, *Chaetomorpha antennina*, *Ulva fasciata*, *Jania intermedia*, *Champia ceylanica*, …) (Fig. 15A). In the dry season (November onwards) these species ‘disappear’ due to overheating and desiccation. As a matter of fact, most of them are still there, but reduced to their crustose basis or present as a short algal turf. Some small specimens can still be found under rock overhangs, in crevices or in shaded intertidal pools. The mid to low intertidal pools on the sheltered, landward side of the rock outcrops also show a very different aspect over the seasons. In the cooler rain season, with huge surf, they are regularly flushed by seawater, stabilizing temperature as well as salinity. They then contain dense vegetations of tubular *Ulva* spp. which disappear in the dry season, when these pools heat up and salinity rises too much due to evaporation.

The first observations of the algal seasonality in Sri Lanka were formulated by Svedelius (1906b). Gunasekara (in prep.) carried out a study on seasonality of seaweed vegetations on rocky outcrops (mainly a beachrock platform in Dickwella) in the framework of his MSc-thesis at the University of Ruhuna (Matara).

Because of this pronounced seasonality of seaweed development, it is absolutely necessary to visit study sites in different seasons to get a complete view of the alpha-diversity of the area.

The seaweeds from the low intertidal and subtidal biotopes are less sensitive to seasonality as they are submerged (or at least continuously wave-swept) most of the time and the seawater temperature does not vary as much as the air temperature. On the other hand, presence of reproductive structures (frequently needed for identification) is mostly seasonal, even in these lower zones.

The seasonality of seagrasses and mangroves is limited to the discrete flowering seasons and the more pronounced loss of leaves in some periods of the year.

5. Zonation

The marine environment can be subdivided in two fundamentally different ecosystems: the intertidal that undergoes the tides twice a day and the subtidal that is continuously submerged.

The seaweeds occurring in the intertidal are subject to variable periods of emersion and submersion from high tide to low tide level. As a result, there is a strong variation of ecophysiological factors such as temperature, salinity, surf, light and desiccation depending on the level in the intertidal. Moreover, competition between different organisms (both plants and animals) also influences the distribution of algae along a shore.

The combination of all these factors results in the presence of superposed zones, mostly parallel to the height of the shore, each with a characteristic species composition of seaweeds and animals. The species from the upper zones are more tolerant to variation of the ecophysiological factors (they are eurytherm, euryhaline and euryionic). Those from the lower zones are less tolerant (they are stenotherm, stenohaline and stenoionic). It is clear that along wave-swept coasts the spray- and splash-zones will be much higher than along sheltered coasts, proving that zonation is not exclusively dictated by tidal levels. So for example, along a harbour wall, the same species will be present in a higher zone along the surf-exposed seaward side, than on the sheltered, harbour side.

In the subtidal and circalittoral zones light, hydrodynamics and siltation are the main factors defining the presence and the distribution of marine organisms.

In the description of the ecological distribution of the taxa included in this book the following zonation terminology is used:

- The **supralittoral**, corresponding with the spray-zone, is dominated by crustose lichens and some blue-greens (Figs 15B, C); it is never submerged by seawater, even at extreme high tide.

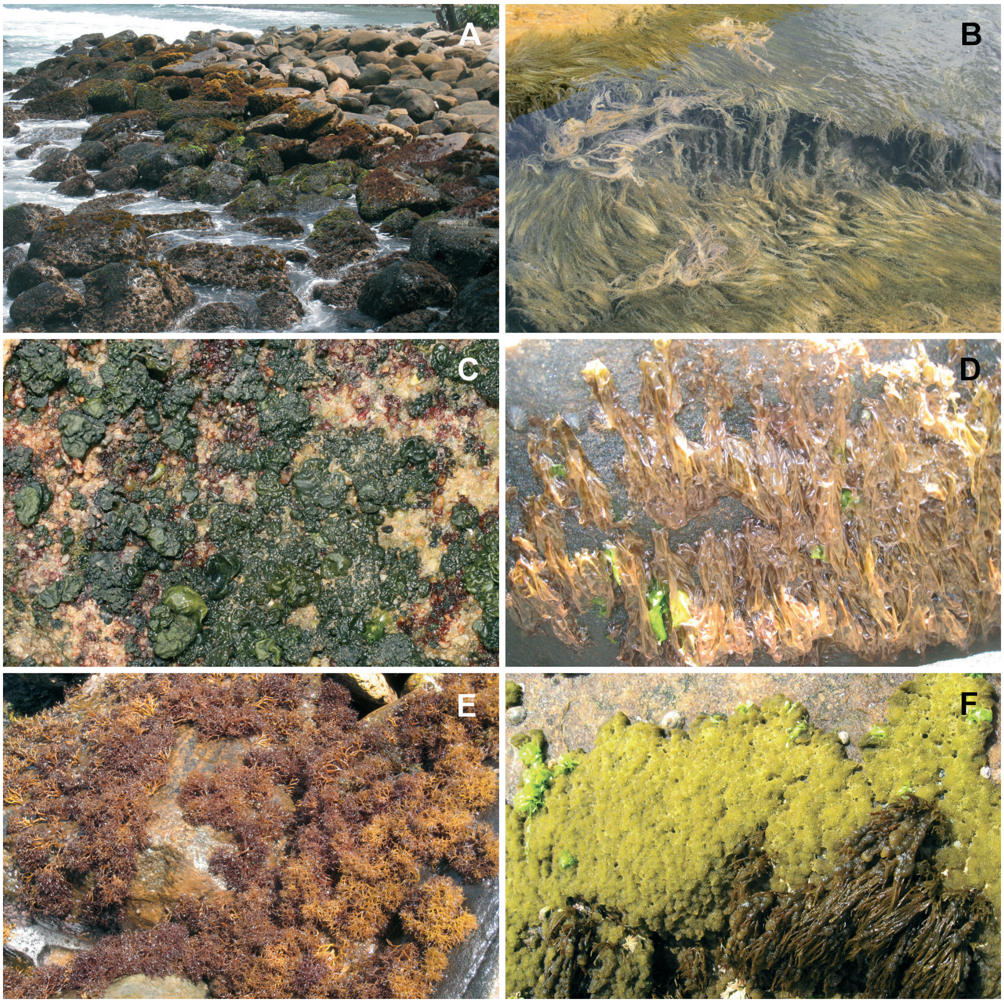

Fig. 15. Seaweed vegetations in the upper intertidal. A. Surf-exposed rocks with dense seaweed cover during the SW-monsoon (Nilwella); B. High intertidal rockpool covered by filamentous blue-greens (Dickwella Resort peninsula); C. The blue-green *Brachytrichia quoyi* on high intertidal rocks (Beruwela); D. *Porphyra* sp. in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella); E. *Dermonema virens* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Nilwella); F. A zone of bleached, short tufts of *Centroceras clavulatum* on top of *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella Resort peninsula).

- The **supralittoral fringe** (the lowermost part of the supralittoral), corresponding with the splash-zone is a relatively arid zone transitional between land and sea; it is only submerged at spring high tides. Relatively few species occupy this zone (and only during the SW monsoon with rough seas, as they completely dry out once the sea is getting calmer). Typical seaweeds in this zone are: *Porphyra* spp. (Fig 15D), *Dermonema virens* (Fig. 15E), *Centroceras clavulatum* (Fig. 15F), *Chnoospora minima*

(Figs 16A, C), *Asteronema breviarticulata* (Fig. 16B), *Ralfsia ceylanica* (Fig. 16C). On the shaded, overhanging walls of the eroded fossil beachrock cliffs, *Rhizoclonium africanum* (Fig. 16D), *Bostrychia tenella* (Fig. 16E) and *Murrayella periclados* (Fig. 16F) form extensive coverings in marked superposed zones.

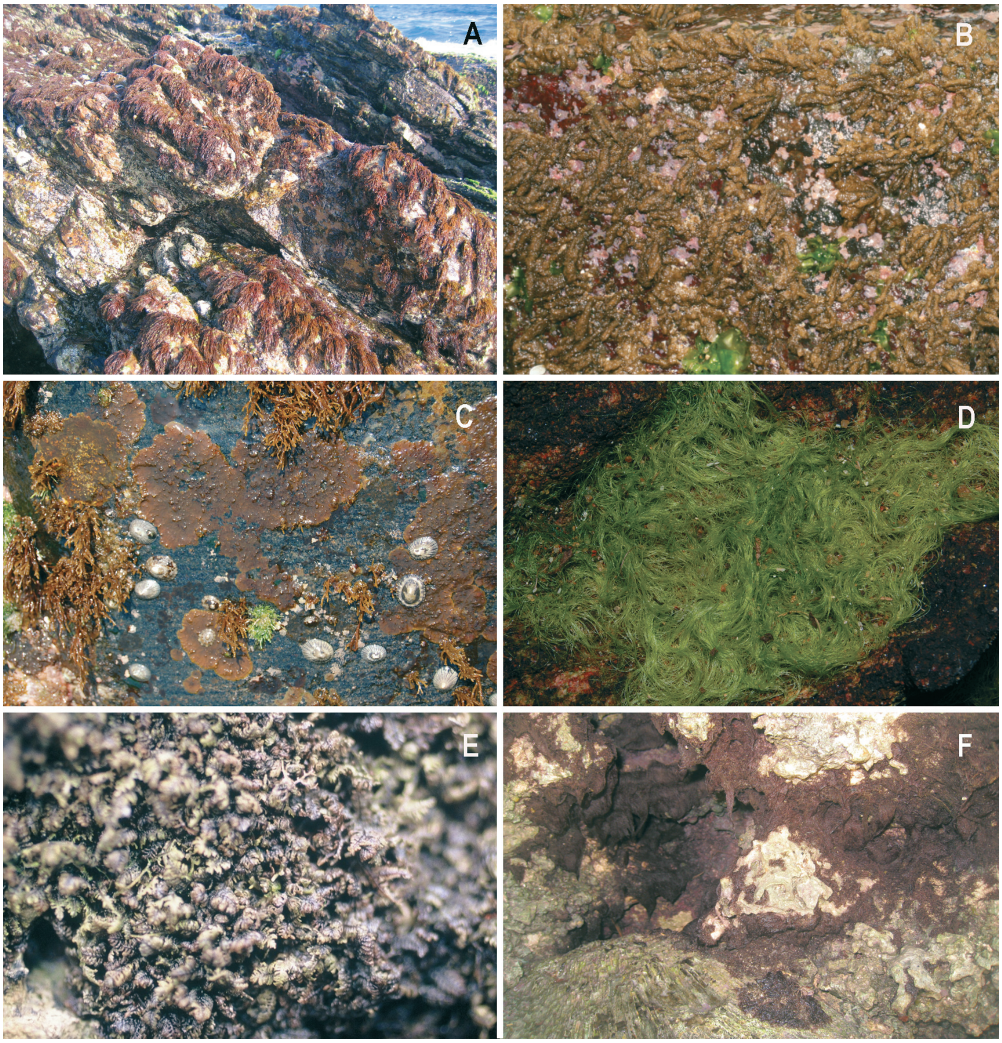

Fig. 16. Seaweed vegetations in the upper intertidal. A. Extensive vegetations of *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Dickwella Resort peninsula); B. The zone of *Asteronema breviarticula* in the supralittoral fringe of surf-exposed coasts during the SW-monsoon season (Unawatuna); C. Brown crusts of *Ralfsia ceylanica*, between *Chnoospora minima* in the supralittoral fringe of surf-exposed coasts (Dickwella Resort peninsula); D. *Rhizoclonium africanum* in the supralittoral fringe of surf-exposed coasts (Unawatuna); E. *Bostrychia tenella* forming dense vegetations on shaded (mostly vertical) rock walls in the supralittoral fringe (Unawatuna); F. *Murrayella periclados* (and other filamentous red algae) forming dense vegetations on shaded (mostly vertical) rock walls in the supralittoral fringe (Matara, Polhena Beach).

Fig. 17. Seaweed vegetations in the upper and mid intertidal. A. *Chaetomorpha antennina* in the upper intertidal of surf-exposed coasts (Unawatuna); B. *Cladophora sericea* in the upper intertidal of the landward side of surf-exposed rocks (Wattale); C. *Ulva fasciata* in the upper intertidal of the landward side of surf-exposed rocks (Dickwella); D. *Jania intermedia* forming extensive vegetations in the middle intertidal along surf-exposed coasts (Dickwella); E. *Champia ceylanica* and *Laurencia natalensis* on crustose *Ralfsia* and Corallinaceae in the middle intertidal along surf-exposed coasts (Nilwella); F. Cascades between low intertidal rock pools (Dickwella); G. Densely intricate, low tufts of *Caulerpa sertularioides* and *C. racemosa* in the cascades between the rock pools (Dickwella); H. Detail of a densely intricated tuft of *C. sertularioides* from a low intertidal cascade (Dickwella).

- The **intertidal**, frequently called eulittoral in anglosaxon literature, roughly corresponds with the zone between mean high water and mean low water levels. On surf-exposed rock outcrops the intertidal is densely covered by macroalgae during the SW monsoon: in the upper intertidal, *Chaetomorpha antennina* (Fig. 17A) is extremely well developed along the seaward, surf-exposed side of rocky shores, whereas *Cladophora sericea* (Fig. 17B) and *Ulva fasciata* (Fig. 17C) are abundant on the landward, more sheltered but still continuously wave-swept side. The middle intertidal is characterized by extensive vegetations of the articulated coralline *Jania intermedia* (Fig. 17D) at sites exposed to extreme surf. Along medium exposed sites, *Laurencia* spp. and *Champia ceylanica* (Fig. 17E) are abundant. In the cascading overflows between intertidal pools, *Caulerpa sertularioides* and *C. racemosa* locally grow in densely intricated, low tufts (Figs 17F-H). In the lower intertidal, large barnacles can be abundant (quite often covered by *Gelidium* sp., Fig. 18A), together with some *Pterocladiella caerulescens* (Fig. 18B), *Ahnfeltiopsis* spp., *Jania cultrata*, … Vertical and overhanging (mostly shaded) walls can be covered by *Botryocladia skottsbergii* (Fig. 18C), and *Codium arabicum* (Fig. 18D).

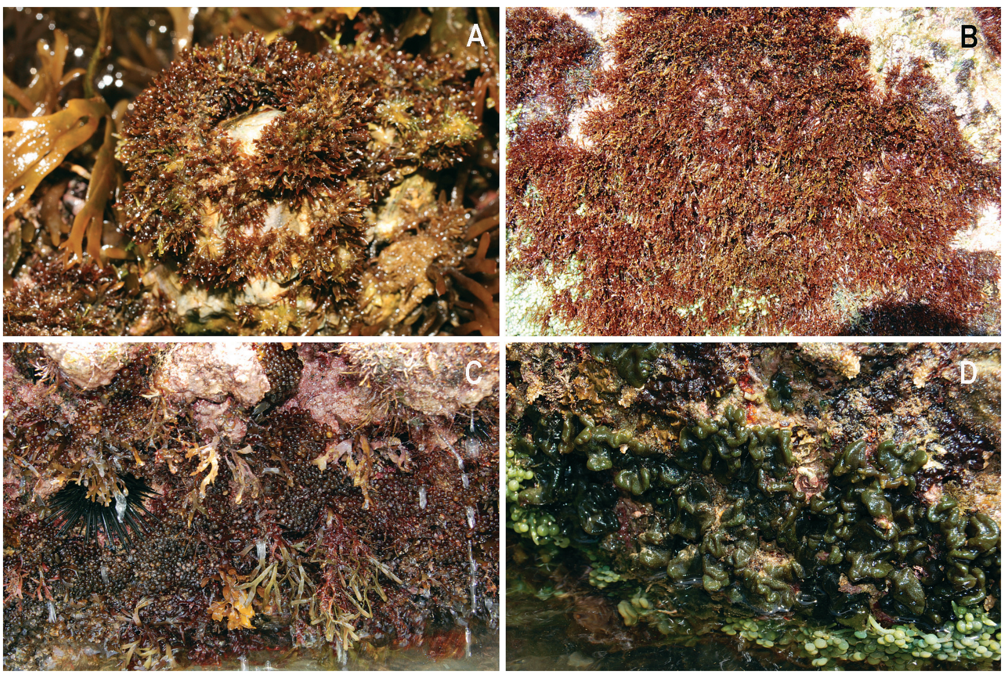

Fig. 18. Seaweed vegetations in the low intertidal. A. A large barnacle covered by a small *Gelidium* sp. and surrounded by *Gracilaria corticata*; B. *Pterocladiella caerulescens* growing in extensive vegetations in the lower intertidal along surf-exposed coasts (Unawatuna); C. *Botryocladia skottsbergii* growing in extensive vegetations on vertical walls in the lower intertidal along surf-exposed coasts (Unawatuna); D. *Codium arabicum* on a vertical wall in the lower intertidal along surf-exposed coasts (Galle).

At about low tide level, continuously wave-swept sloping to horizontal rock surfaces are covered by vegetations of different composition from the seaward to the landward side (Fig. 19A). On the extremely wave-swept seaward side, *Dictyosphaeria versluysii* (Fig. 19B) can be abundant, whereas *Turbinaria ornata* f. *evesiculosa* develops on seaward horizontal surfaces (Figs 19C, D), followed by a zone of *Sargassum turbinatifolium* (Fig. 19E). The middle part is covered by mixed seaweed vegetations where some species can be dominant, e.g. *Sargassum* sp. (Fig. 19F),

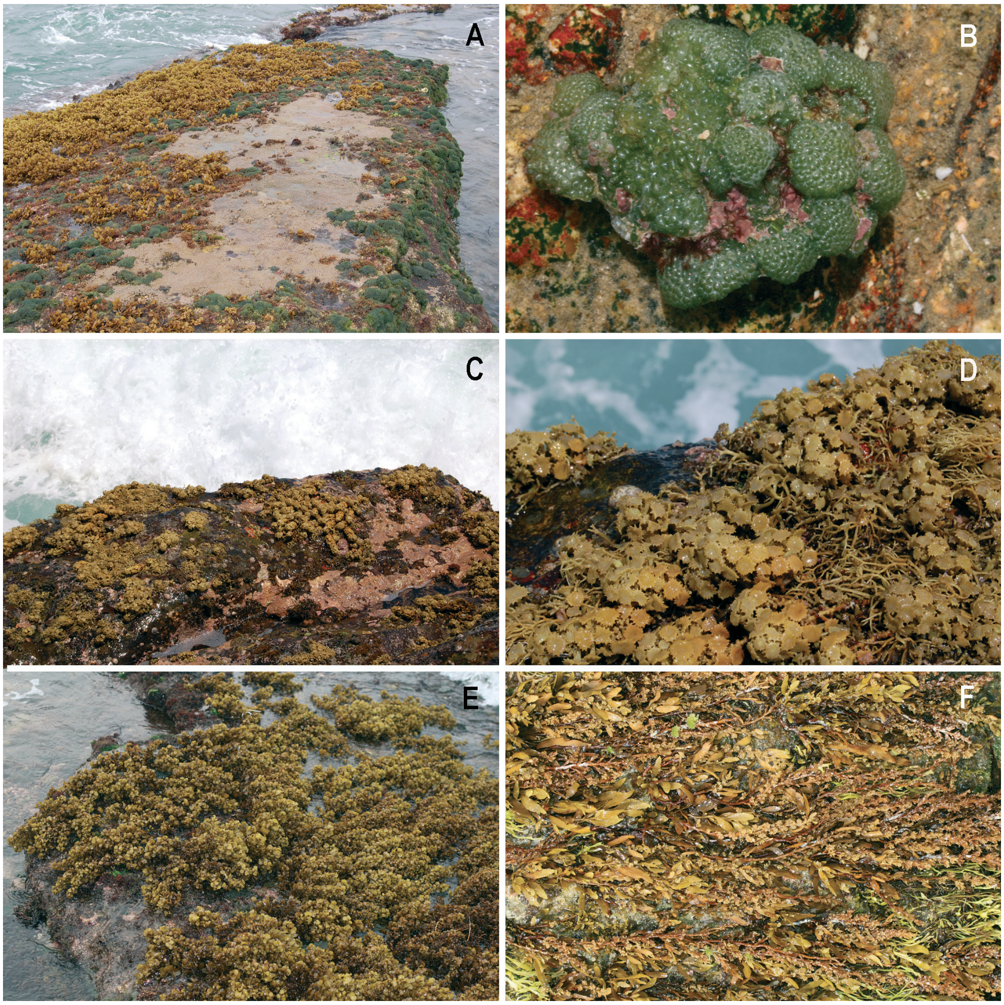

Fig. 19. Seaweed vegetations at about low tide level. A. Lower intertidal of a beachrock platform with *Sargassum turbinatifolium* on the seaward (surf-exposed) side and *Valoniopsis pachynema* on the landward (more surf-sheltered) side (Beruwela); B. *Dictyosphaeria versluysii* in the lower intertidal on the surf-exposed, seaward side of the beachrock platform (Beruwela); C, D. *Turbinaria ornata* f. *evesiculosa* at low tide level along extremely surf-exposed rocky coasts; E. *Sargassum turbinatifolium* at low tide tide level along surf-exposed rocky coasts; F. *Sargassum* sp.-vegetations in the middle part of beachrock platforms at about low tide level.

Hypnea pannosa (Fig. 20A), *Pterocladiella caerulescens*, *Caulerpa racemosa* f. *macrophysa* (Fig. 20B), *C. imbricata* (Fig. 20C) or combined with numerous species such as *Polyopes ligulatus*, *Gracilaria corticata*, *G. salicornia*, *Laurencia* spp., *Caulerpa sertularioides*, *Dictyopteris delicatula*, *Bryopsis pennata*, *Chlorodesmis caespitosa*, *Gelidiella acerosa, Spyridia hypnoides*, … On the more sheltered, landward side, *Valoniopsis pachynema* is a common green alga forming extensive cushions (Fig. 20D) next to *Dictyosphaeria cavernosa* (Fig. 20E). On vertical walls, *Portieria tripinnata* develops on the seaward side, whereas *Caulerpa lentillifera* (Fig. 20F) and *Dictyurus purpurascens* grow on the more sheltered, landward walls.

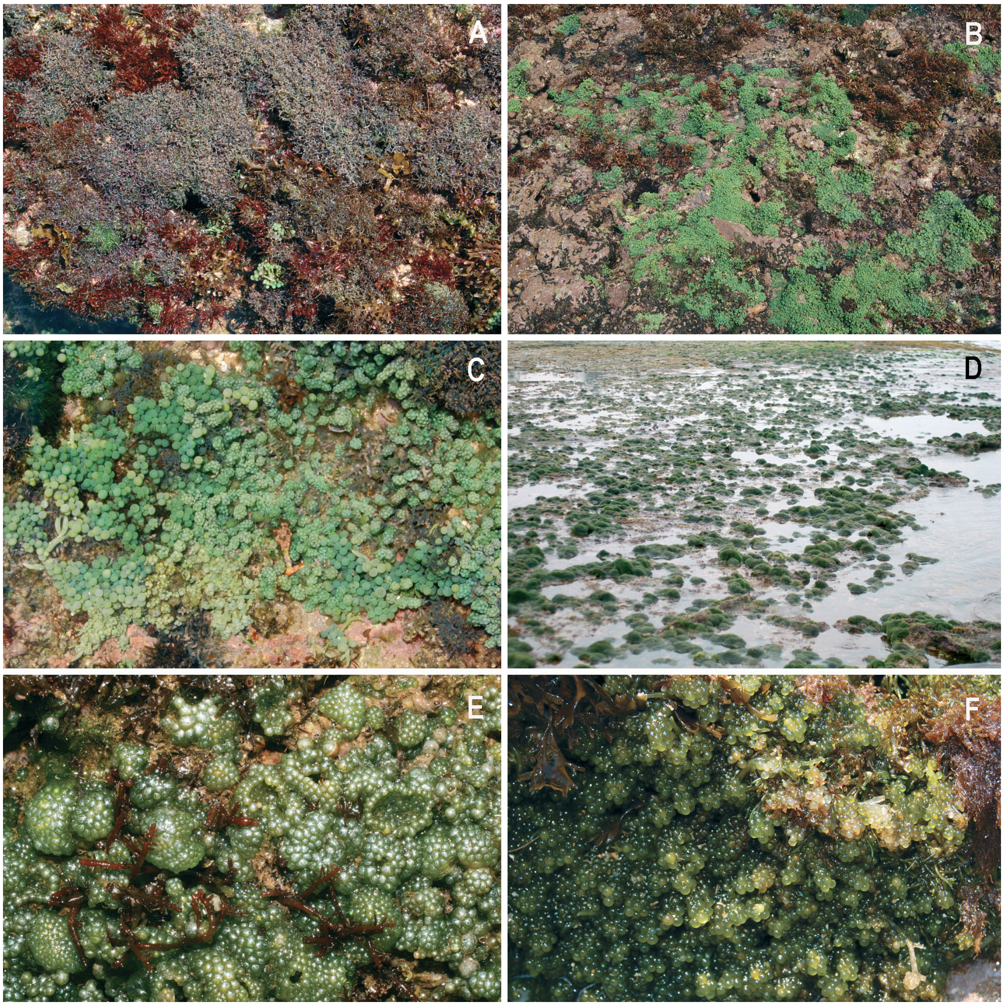

Fig. 20. Seaweed vegetations at about low tide level. A. Mixed seaweed vegetation with dominance of *Hypnea pannosa* and *Pterocladiella caerulescens* in the lower part of beachrock platforms at about low tide level; B. Mixed seaweed vegetation with dominance of *Caulerpa racemosa* and *Polyopes ligulatus* in the lower part of beachrock platforms at about low tide level; C. Mixed vegetation of *Caulerpa racemosa* and *C. imbricata* in the lower part of beachrock platforms at about low tide level; D. Numerous hemispherical cushions of *Valoniopsis pachynema* at about low tide level; E. *Dictyosphaeria cavernosa* (mixed with some *Gelidiella acerosa*) at about low tide level along more sheltered coasts (Beruwela); F. *Caulerpa lentillifera* on sheltered, landward vertical walls of the beachrock platform (Dickwella).

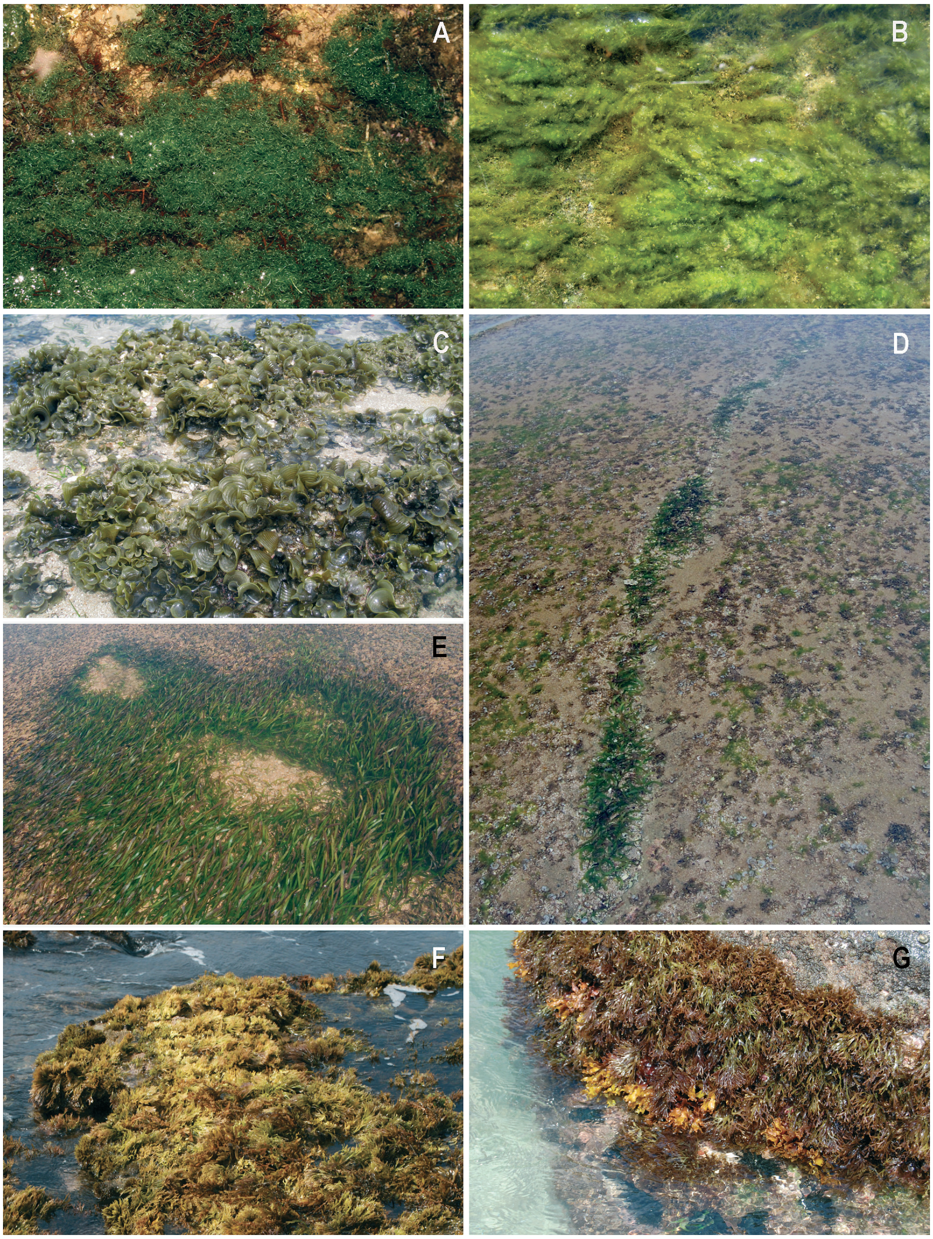

Fig. 21. Seaweed vegetations at about low tide level. A. *Chaetomorpha crassa* intertwined to *Gelidiella acerosa* in shallow pools at about low tide level (Beruwela); B. *Cladophora vagabunda* populations in shallow, rather sheltered but regularly wave-swept low intertidal pools (Beruwela); C. *Padina boergesenii* populations in shallow, rather sheltered low intertidal pools; D. A sand-filled crevice of the beachrock platform at about low tide with development of seagrasses (Beruwela); E. A low intertidal rock pool with sandy bottom covered by seagrasses (Beruwela); F. Subhorizontal surface of the beachrock platform at low water level, covered by extensive vegetations of *Gracilaria corticata* and *Sargassum* (Chilaw); G. A vertical wall at low water level, covered by a vegetation of *Gracilaria corticata* and some *Sarcodia montagneana* plants (Unawatuna).

In places, low intertidal pools contain large amounts of *Chaetomorpha crassa* (Fig. 21A) intertwined to *Sargassum* spp. and *Gelidiella acerosa*. Other low intertidal pools are covered by *Cladophora vagabunda* (Fig. 21B) or *Padina* spp. (Fig. 21C). In sand-filled crevices and pools with a sandy bottom seagrasses can develop (Figs 21D, E). In other areas, the subhorizontal surface of the beachrock platform at low water level is covered by extensive vegetations of *Gracilaria corticata* (Figs 21F, G).

- The **infralittoral fringe** is air-exposed only during spring tides when the sea is smooth, but generally this zone is continuously wave-swept, even at low tide. Subtidal species survive in rock pools and surge channels close to extreme low water level. *Amphiroa foliacea* (Fig. 22A), *Halimeda discoidea* (Fig. 22B), *Valonia fastigiata* (Fig. 22C), *Caulerpa verticillata* (Fig. 22D), *C. taxifolia* (Fig. 22E), *Halimeda opuntia* (Fig. 22F), *Polyopes ligulatus* (Fig. 22G), *Sarcodia montagneana*, *Carpopeltis maillardii*, *Chondria armata* (Fig. 22H), *Jania cultrata, Laurencia* spp. (Fig. 22I) are among the numerous air-exposed algae between waves at low water. *Dictyota ceylanica* (Fig. 23A), *Asparagopsis taxiformis* (Fig. 23B) and *Spyridia hypnoides* (Fig. 23C) can be frequent algae forming isolated tufts, mainly in pools. In surge channels, *Gracilaria canaliculata* can be well developed (Fig. 23D). On sand-covered rock substratum, a typical seaweed vegetation can be observed, composed of *Bryocladia thwaitesii* (Fig. 23E), *Grateloupia lithophila* (Fig. 23F), *Ulva fasciata*.

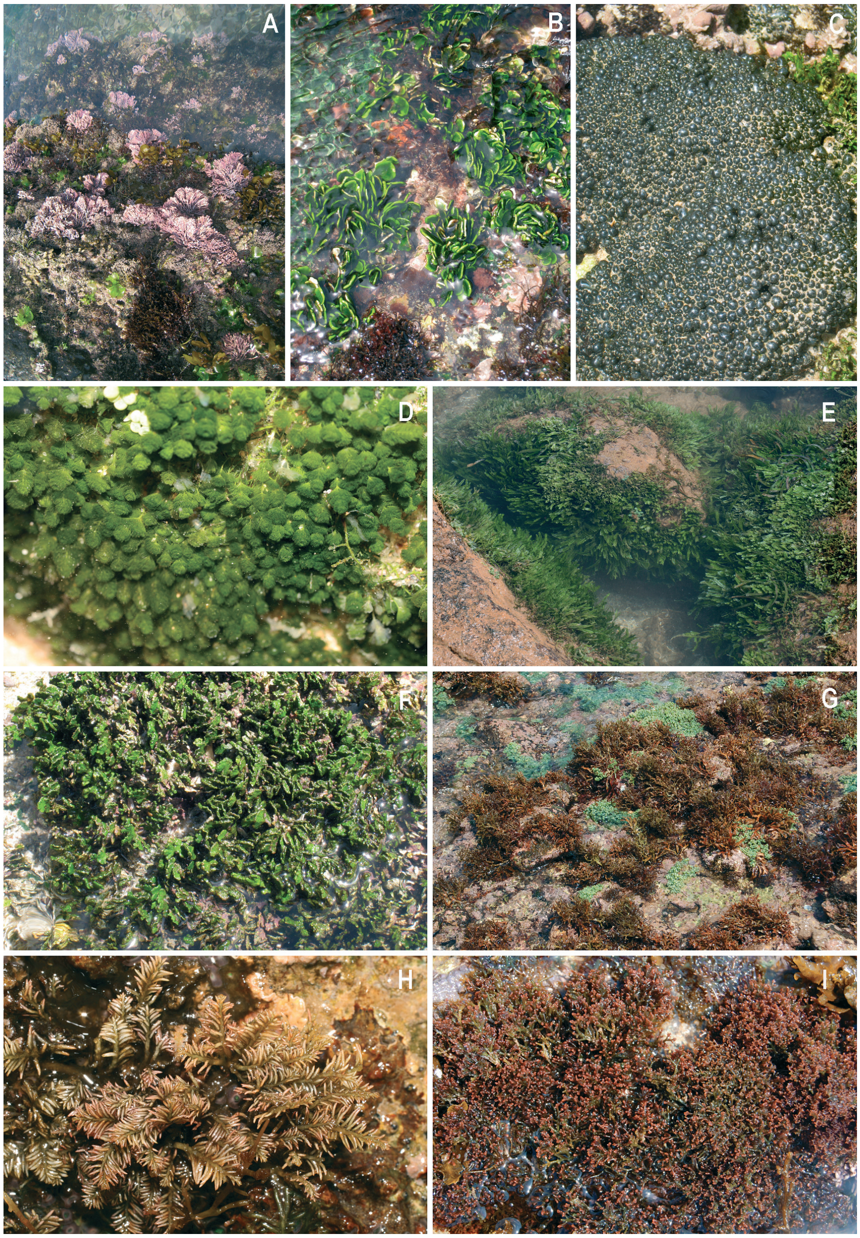

Fig. 22. Seaweed vegetations at and just under low tide level. A. *Amphiroa foliacea* just under low water level in surge channels; B. *Halimeda discoidea* in the infralittoral fringe (Nilwella); C. *Valonia fastigiata* in the infralittoral fringe (Nilwella); D. *Caulerpa verticillata* on sheltered, landward vertical walls of the beachrock platform (Dickwella); E. *Caulerpa taxifolia* mainly on vertical walls just under low water level (Weligama); F. *Halimeda opuntia* in the infralittoral fringe, partly air-exposed at extreme low water (Nilwella); G. *Polyopes ligulatus* (mixed to *Caulerpa racemosa* and *Gracilaria* crassa) in the infralittoral fringe, partly air-exposed at extreme low water (Galle); H. *Chondria armata* in the infralittoral fringe, air-exposed at extreme low water; I. *Laurencia natalensis* in the infralittoral fringe, partly air-exposed at extreme low water (Batheegama).

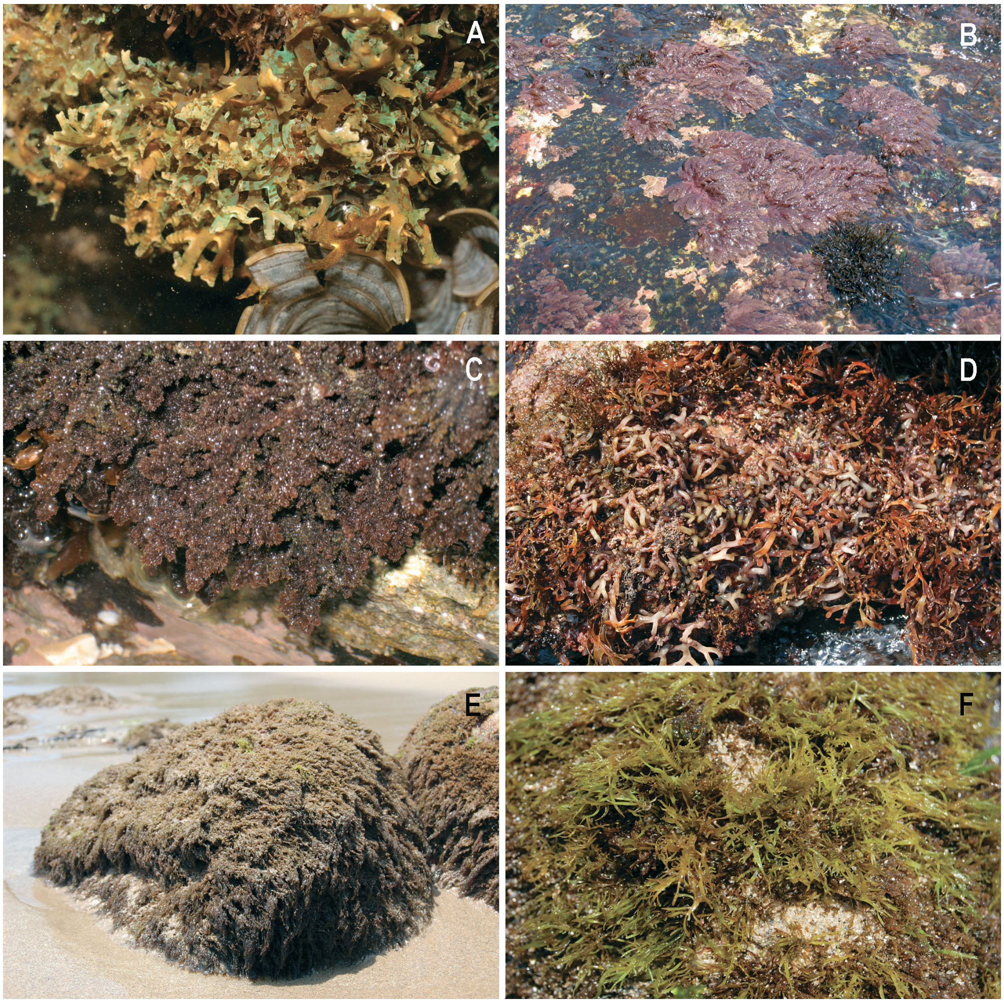

Fig. 23. Seaweed vegetations at and just under low tide level. A. Cushions of *Dictyota ceylanica* in the infralittoral fringe (Hikkaduwa); B. *Asparagopsis taxiformis* in a rock pool at about low water level (Nilwella); C. Populations of *Spyridia hypnoides* in the infralittoral fringe (Nilwella); D. *Gracilaria crassa* (together with *Polyopes* ligulatus) in surge channels in the infralittoral fringe (Galle); E. Monospecific vegetations of *Bryocladia thwaitesii* on partly sand-covered rocks in the infralittoral fringe of sheltered bays (Dickwella); F. Monospecific vegetations of *Grateloupia lithophila* on partly sand-covered rocks in the infralittoral fringe of sheltered bays (Dickwella).

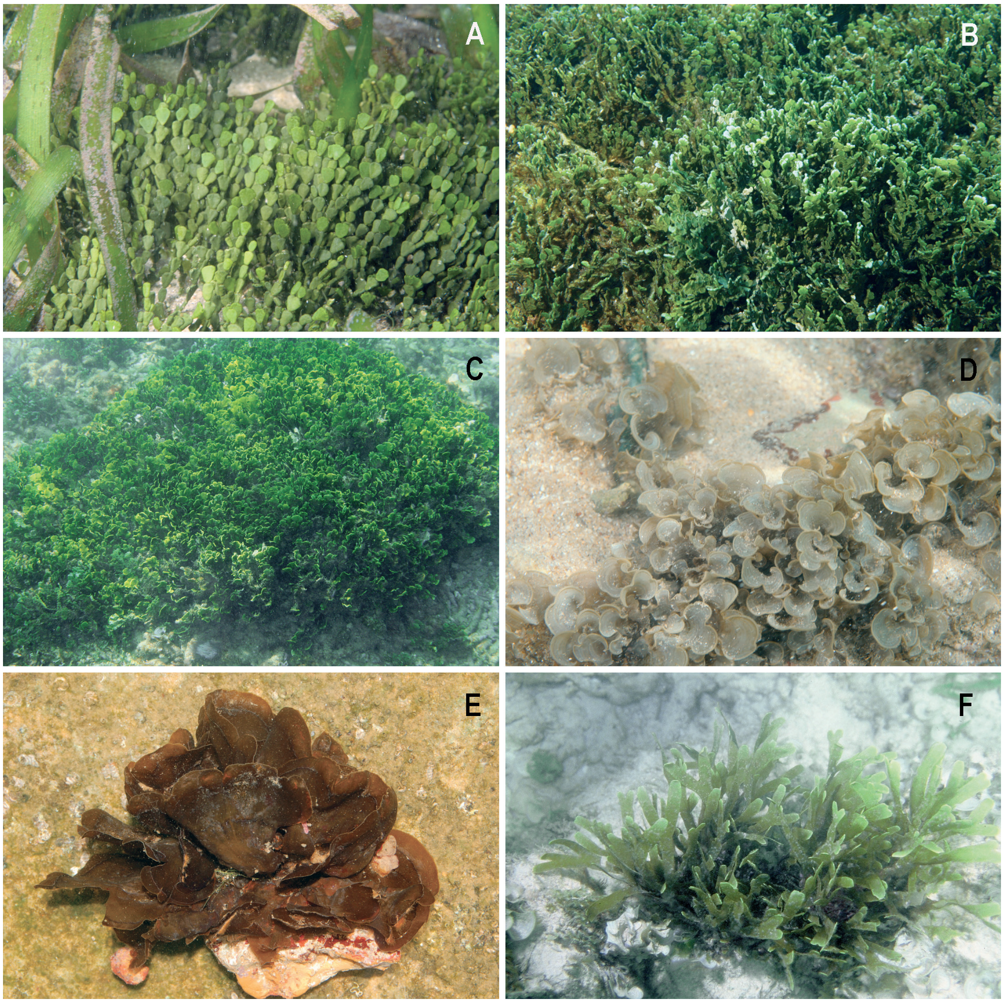

Fig. 24. Seaweed vegetations in the shallow subtidal. A. *Halimeda gracilis* populations mixed to seagrasses in the subtidal (Weligama); B. Dense *Halimeda gracilis* vegetations on coral rubble (Kalpitiya); C. Dense *Halimeda discoidea* vegetations on coral rubble (Kalpitiya); D. *Padina boergesenii* on coral debris in the subtidal of a lagoon (Weligama); E. A large, erect plant of *Lobophora variegata* on a dead coral fragment on the bottom of a lagoon (Beruwela); F. *Stoechospermum polypodioides* on dead coral in the lagoon (Weligama).

- The **infralittoral** or **subtidal** is continuously covered by seawater. On sand-covered rocky substratum *Caulerpa racemosa* var. *cylindracea* f. *laxa* can locally form nice populations.

In lagoons with sandy substratum, seagrass meadows develop, with the associated macro-algae on the sand (mainly *Halimeda gracilis*, Fig. 24A) or epiphytic on the sea-grasses. When coral rubble is present on the lagoon bottom *Halimeda gracilis* and *H. discoidea* can grow in extensive vegetations (Figs 24B, C); tufts of *Padina* spp. (Fig. 24D),

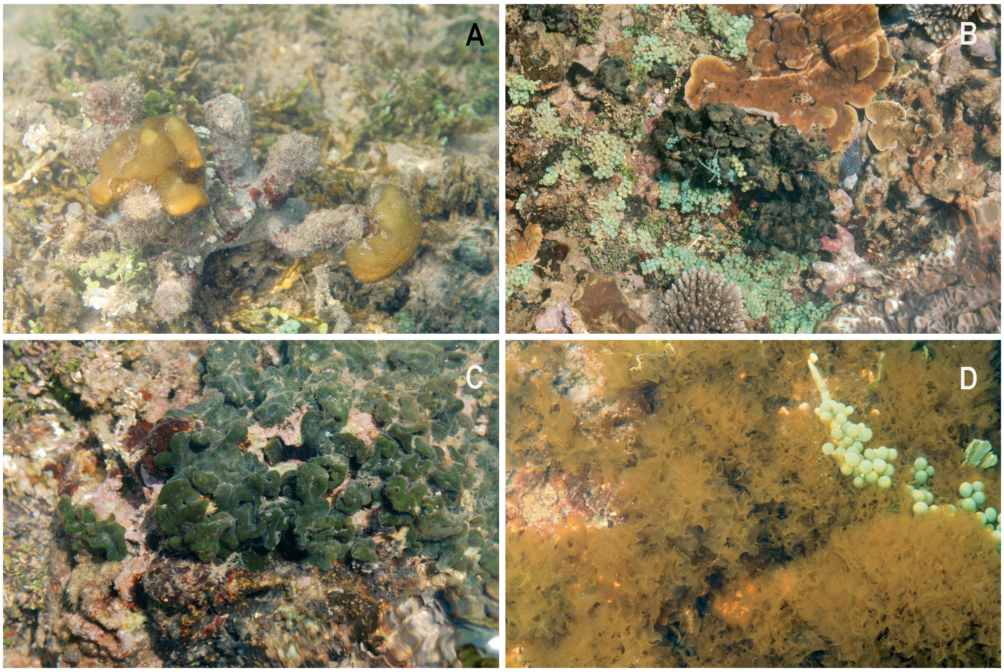

Fig. 25. Seaweed vegetations in the shallow subtidal. A. *Colpomenia sinuosa* on dead coral in the lagoon (Weligama); B. *Avrainvillea amadelpha* next to *Caulerpa racemosa* and *Halimeda opuntia* on hard substrate in the shallow subtidal (Galle); C. Extensive vegetations of *Codium arabicum* on hard substrate in the shallow subtidal (Galle); D. A dense cover of *Nitophyllum marginatum* on hard substrate in the shallow subtidal (Galle).

Lobophora variegata (Fig. 24E) and *Dictyota* spp. can also develop. Locally, extensive populations of *Stoechospermum polypodioides* (Fig. 24F) are present and *Colpomenia sinuosa* can be abundant (Fig. 25A).

In lagoons with hard substratum (Galle), corals develop, together with *Halimeda opuntia*, *Avrainvillea amadelpha* (Fig. 25B), and locally populations of *Caulerpa sertularioides*, *C. racemosa*, *C. imbricata*, *Codium arabicum* (Fig. 25C), *C. geppiorum, Dictyota ceylanica*, *Nitophyllum marginale* (Fig. 25D), *Claudea multifida*.